Rethinking the Relationship between Humans and Computers

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Human-engaged computing aims to synergize innate human capacities and technological capabilities to enable us to realize our full potential and solve complex real-world problems.

When designing for human–computer interaction (HCI), the focus should always be on the human, not the computer. Otherwise, computing systems could, at the least, limit innovation and, at worst, put our lives at risk. I believe this is already happening.

Some of today's leading HCI experts share similar views. Touchscreen innovator Bill Buxton wrote that computers should enable people to realize their full potential.[1] Ben Shneiderman, a pioneer of direct manipulation, said that future HCI design should improve both individual and societal outcomes by encouraging "trust, empathy, and responsibility."[2] Terry Winograd and Gary Bradski recognized the limitations of AI in natural language processing and computer vision, respectively, and shifted their focus to enhancing human capacities.[3]

Despite such calls, researchers haven't adequately explored the use of information technology to fully realize our innate capabilities. Instead, IT has largely been used to automate tasks to achieve greater efficiency and productivity. However, this hasn't led to intrinsically better human outcomes. In fact, in many cases automation ironically has created problems such as imposing added time pressure on human decision making.[4]

Stephen Hawking, Bill Gates, and Elon Musk have all expressed concerns about the negative impact of "super AI" on human progress and survival prospects. This anxiety is echoed by the public. A 2016 Accenture survey of 28,000 consumers in 28 countries found that people are bored with today's technology and worried about its threats to their security and privacy.[5]

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Is digital development serving humanity, or vice versa? Are we only technology consumers, conditioned to satisfy corporate bottom lines, or should technology help us realize our full potential? Such questions are critical to our future prospects.

COMPUTING FOR HUMAN POTENTIAL

In 2006, Douglas Engelbart, the visionary who defined the predominant HCI paradigm, wrote to me that HCI design should increase "human capabilities to develop, integrate and understand the knowledge required for improving society's survival probability." This motivated me to rethink the relationship between humans and computers.

Pioneers like Engelbart and J.C.R. Licklider had no intention of neglecting innate human potential or of abandoning technological progress. "Men will set the goals ... and perform the evaluations," Licklider wrote in 1960. "Computing machines will ... prepare the way for insights and decisions in technical and scientific thinking."[6] Engelbart made the same point at the 1995 Vannevar Bush Symposium: "You have to deal with both sides of the whole organization, i.e., the people and the machines—we need to find a way where both sides are going to co-evolve."[7]

Existing conceptions that take a more holistic view of HCI inadequately capture this co-evolution. For example, human-centered computing (HCC) focuses on "user needs,"[8] but HCC is often equated with convenience or fun. User experience (UX) considers human emotions and values but is arguably still technology oriented, as UX is rooted in industrial and product design. MIT's Center for Collective Intelligence (http://cci.mit.edu) explores "how people and computers can work together more intelligently," but intelligence is only a small part of human potential.

SYNERGIZING HUMAN CAPACITIES AND TECHNOLOGICAL CAPABILITIES

To achieve the high-level wisdom needed to solve complex real-world problems, HCI researchers must synergize human capacities and technological capabilities. Effective synergism requires thoroughly identifying human capacities, identifying technological hindrances to realizing such capacities, and developing novel technologies to enhance those capacities.

Eastern philosophies recognize that humans possess powerful inner capacities, some of which aren't measurable. Traditional HCI limits human capacities to cognition as well as perception and motor control. However, recent research indicates that raw intelligence alone isn't a sure predictor of excellence—"softer" skills such as focus, mindfulness, self-control, self-motivation, empathy, and trust can play an even greater role.[9,10] More fully synergized HCI can only occur when the system properly recognizes all individual and collective human capacities.

Every technological innovation comes at a human cost. For example, using digital address books can significantly diminish our memory, while continuous interaction with digital devices can hamper our ability to focus. A recent Microsoft study concluded that our attention span is now lower than that of a goldfish.[11] If this trend continues, our natural capacities will decrease to the point at which the achievment of more deeply synergized HCI will be significantly limited.

As a first step to developing better computing systems, we must comprehensively define, evaluate, and prioritize human capacities as well as technological hindrances to those capacities by integrating research insights from multiple disciplines. For example, synthesizing findings from neuroscience and positive psychology would help HCI researchers understand the costs and benefits of various technologies to mental development, such as being more easily distracted or less able to regulate emotions on the one hand and being better able to multitask on the other. In the case of a technology such as self-driving cars, researchers must consider under what circumstances surrendering control to AI is beneficial or detrimental in terms of overall human outcomes.

Once human capacities have been thoroughly assessed, HCI researchers can synergize these with technological capabilities to maximize symbiosis (complementarity) and minimize antibiosis (conflict) between users and computers. Research indicates that our brain is malleable, consistently adapting to external responses.[12] By altering the user experience with appropriate technology, HCI designers could preserve, enhance, and even restore human capacities. For example, mindfulness apps such as Headspace (www.headspace.com) and Smiling Mind (http://smilingmind.com.au) can reduce stress and improve focus and self-control, while crowdsourcing apps provide a means to exploit commonly accessible collective human capacities and help build social trust, empathy, and community. In some cases, human capacities might be better off without technological intervention.

HUMAN-ENGAGED COMPUTING

I refer to the synergism of human capacities and technological capabilities as human-engaged computing (HEC), which is graphically conceptualized in Figure 1. HEC has three components: engaged humans, engaging computers, and synergized interaction.

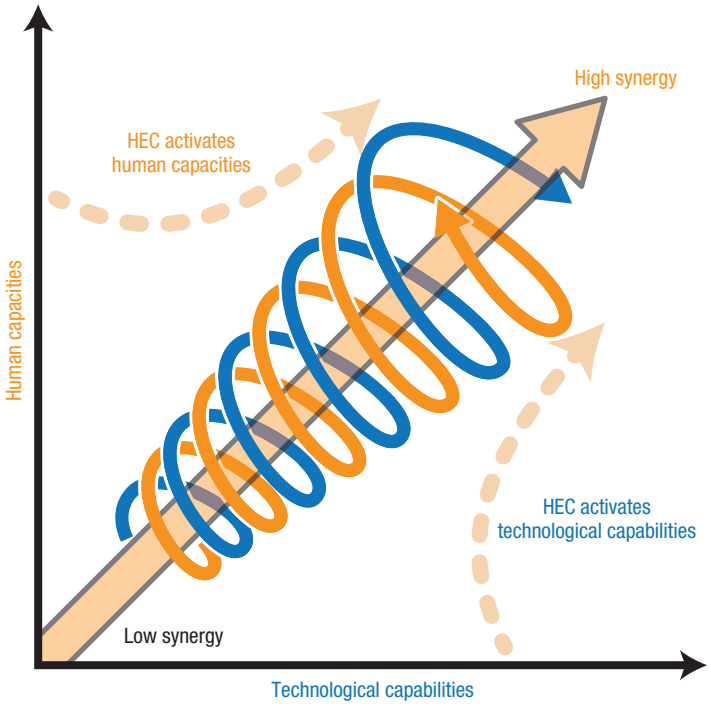

Figure 1. Human-engaged computing (HEC) synergizes innate human capacities and technological capabilities by maximizing symbiosis and minimizing antibiosis between users and computers.

Engaged humans

Humans are engaged when their inner capacities are progressively developed and thoroughly integrated into a given activity. In its purest form, engagement isn't dependent on the nature of the activity—for example, on whether it's entertaining or boring, difficult or easy, profitable or not. Rather, it's a state of consciousness in which one is fully immersed in and aligned with the activity. This feeling of energized focus is well known in Eastern practices such as mindfulness meditation and "no-mind" martial arts, and in Western psychology it's variously described as "achieving flow," "being in the zone," and the like. Pure human engagement can't be produced by external incentives such as fun mechanisms because these require a divided mind.

Engaging computers

Computers (including both devices and software applications) are engaging when they enhance human capacities. In other words, the merits of technologies in HEC aren't determined by traditional quantitative or qualitative metrics, such as whether they increase productivity or are fun to use, but by their ability to realize human potential.

A key challenge in designing such systems is determining what to do if a technology increases one capacity but decreases other capacities. For example, playing certain types of games might improve short-term learning outcomes for children, but children might also gradually lose their natural capacity to self-motivate. Should we stop teaching students basic mathematics because computing tools are available? Is it wise to facilitate the attenuation of thinking, spelling, writing, coordination, and other skills because a device can do these for us? What will happen when our kids face complex problems that need a sound composite of human capacities and technological capabilities? The role of HEC is to raise awareness by constantly asking such questions.

Synergized interaction

Synergized interaction refers to a state of optimal balance between engaged humans and engaging computers, an Eastern concept detailed in the sidebar "Human-Engaged Computing: Getting the Balance Right." In this harmonious state, computing technology isn't merely harnessed to accomplish some predefined goal or purpose; for example, to do something faster or more efficiently. Instead, the technology is designed to complement and enhance human capacities—both existing and potential—to achieve a higher-level and perhaps as-yet undefined purpose. In some cases, synergized interaction might mean not deploying an otherwise useful technology.

A holistic consideration of our innate capacities and technological hindrances to those capacities is essential to achieving greater synergy between humans and computers. By drawing on the unique perspectives of multiple disciplines—including the social sciences and humanities as well as different fields within the HCI community—we can design systems that will enable us to realize our full potential and create a better world.

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HUMAN-ENGAGED COMPUTING: GETTING THE BALANCE RIGHT

The field of human–computer interaction (HCI) has evolved over the years in four waves. The first wave focused on human factors in the context of industrial engineering and ergonomics—optimizing the fit between humans and machines.[1,2] The second wave, inspired by cognitive psychology, emphasized the similarity between human and machine information processing.[3] The third wave shifted the research focus to humans by addressing some of the social and emotional aspects of HCI.[4,5] The fourth and current wave incorporates insights from positive psychology and cognitive neuroscience to assume an even more human-centered perspective that considers factors such as physical and psychological well-being, creativity, emotions, ethical values, and self-realization.[6–9]

Human-engaged computing (HEC) shares some of the goals of fourth-wave HCI research but focuses on identifying ways to engage humans to realize their full potential. It combines the concept of human–computer symbiosis first articulated in the early 1960s by Joseph Licklider[10] and Douglas Engelbart[11] with the Chinese philosophy of the "right balance" espoused in ancient texts such as the *I Ching* and Confucian norms such as Chung Yung (Doctrine of the Mean).[12] The right (also called optimal or golden) balance is a state of complementarity between interacting partners such that together they achieve more than they could independently. The implication of this for HCI is that humans and computers should receive proportional, not equal, treatment according to their respective contributions to overall harmony in any given interaction. Naively apportioning equal resources to unequally contributing partners leads to antibiosis—an inefficient wastage of effort on one partner and neglect of the other. Put simply, there are few situations in which the right balance means expenditures on the constituent elements will be quantitatively equal. Despite this, both elements are indispensible to the synthesis regardless of the respective apportioning of expenditures. The key criterion in making this determination is what best enhances human potential.

The Eastern influence in HEC can also be seen in concepts including wholeness, well-being, mindfulness, and absorption, which have received a lot of attention lately from companies like Apple, Facebook, and Google. In this respect, HEC represents a cross-fertilization of computing with Eastern-based psychological and experiential practices.

Other fields have successfully integrated Eastern and Western approaches including yoga psychotherapy,[13] herbalism,[14] and business management.[15,16] Combining the holistic nature of eastern awareness with the analytical nature of western thought could provide the most effective means to use computing to meet real human needsI.[17]

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